Chapter 7
Practical Application

ABSTRACT

In this chapter, we pay our attention to the two practical applications (Microgrid and Multi-Motors driven) for the proposed methods.

7.1 APPLICATION TO MICROGRID

Motivated by environmental deterioration and energy security, there is a global trend toward the use of renewable energy sources (RES). Power network with large-scale renewable energy such as solar and wind energy has become the trend of modern power industry, and the trend impacting on power systems is more and more prominent (Ding, Xu, Wang, Wang, Song, & Chen, 2016). Recently, a great deal of attention has been devoted to the control of micro-grid systems using the recent developed nonlinear control theory, particularly the decentralized control (Etemadi, Davison, & Iravani, 2012; Mohamed & El-Saadany, 2008) and the distributed control (Anand, Fernandes, & Guerrero, 2013; Sun, Zhang, Xing, & Guerrero, 2011) to distributed energy resource units.

Here, consider a solar photovoltaic (PV) power systems using DC/DC converter as shown in Figure 1, which dynamic model can be given by
Figure 1. PV power system

\[
\begin{align*}
\dot{V}_{pv} &= \frac{1}{C_{pv}} (i_{pv} - i_L u) \\
\dot{i}_L &= \frac{1}{L} (R_0 (i_1 - i_L) - R_L i_L - V_0 + (V_D + V_{pv} - R_M i_L) u) - \frac{V_D}{L} \\
\dot{V}_0 &= \frac{1}{C_0} (i_L - i_1)
\end{align*}
\]

where \( V_{pv}, i_L, \) and \( V_0 \) are the PV array voltage, the current on the inductance \( L \), and the voltage of the capacitance \( C_0 \), respectively; \( R_0, R_L, \) and \( R_M \) are the internal resistance on the capacitance \( C_0 \), the inductance \( L \), and the power MOSFET, respectively; \( V_D \) is the forward voltage of the power diode; \( i_1 \) is the measurable load current.

Then, consider a permanent magnetic synchronous generator (PMSG) as shown in Figure 2, where it’s dynamic model in rotor reference frame can be given by
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